

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1-31 (Cancelled)

Claim 32 (new): A process for the preparation of estra-1,3,5(10)-trien-3,15 α , 16 α , 17 β -tetraol (1), comprising the steps of:

- 1) converting estrone (7) into 3-A-oxy-estra-1,3,5(10),15-tetraen-17-one (6), wherein A is a protecting group;
- 2) reduction of the 17-keto group of 3-A-oxy-estra-1,3,5(10),15-tetraen-17-one (6) to 3-A-oxy-estra-1,3,5(10),15-tetraen-17 β -ol (5);
- 3) protection of the 17-OH group of 3-A-oxy-estra-1,3,5(10),15-tetraen-17 β -ol (5) to 3-A-oxy-17-C-oxy-estra-1,3,5(10),15-tetraene (4), wherein C is a protecting group;
- 4) oxidizing the carbon-carbon double bond of ring D of 3-A-oxy-17-C-oxy-estra-1,3,5(10),15-tetraene (4) to protected estetrol (3); and
- 5) removing the protecting groups, wherein protecting group A is removed first to form 17-OC protected estetrol (2) and subsequently protecting group C is removed to form estetrol (1);

wherein the protecting group A is selected from the group consisting of a C₁-C₅ alkyl group and a C₇-C₁₂ benzylic group and the protecting group C is selected from monofunctional aliphatic hydroxyl protecting groups.

Claim 33 (new): The process according to claim 32, wherein the protecting group is a C₇-C₁₂ benzylic group.

Claim 34 (new): The process according to claim 32, wherein the protecting group is a benzyl group.

Claim 35 (new): The process according to claim 32, wherein the protecting group C is selected from monofunctional aliphatic hydroxyl protecting groups.

Claim 36 (new): The process according to claim 35, wherein the monofunctional aliphatic hydroxyl protecting group is acetyl.

Claim 37 (new): The process according to claim 32, wherein the reduction of the carbonyl group is carried out using a reducing agent selected from the group of metal hydride compounds.

Claim 38 (new): The process according to claim 37, wherein the metal hydride compound is selected from the group consisting of LiAlH₄, NaBH₄, NaBH(OAc)₃, ZnBH₄, and NaBH₄/CeCl₃.

Claim 39 (new): The process according to claim 38, wherein the metal hydride compound is NaBH₄ in combination with CeCl₃ hydrate.

Claim 40 (new): The process according to claim 32, wherein the oxidation of the carbon-carbon double bond in ring D is carried out with an oxidizing agent comprising osmium tetroxide.

Claim 41 (new): The process according to claim 40, wherein the oxidizing agent is osmium tetroxide immobilized on PVP (OsO₄-PVP).

Claim 42 (new): The process according to claim 32, wherein the oxidation of the carbon-carbon double bond in ring D is carried out with a catalytic amount of OsO₄-PVP.

Claim 43 (new): The process according to claim 42, wherein the OsO₄-PVP is used in combination with a co-oxidant.

Claim 44 (new): The process according to claim 43, wherein the co-oxidant is selected from the group consisting of trimethylamine-N-oxide, N-methylmorpholine-N-oxide and hydrogen peroxide.

Claim 45 (new): The process according to claim 44, wherein the co-oxidant is trimethylamine-N-oxide.

Claim 46 (new): The process according to claim 32, wherein the protective C₇-C₁₂ benzylic group is removed by catalytic hydrogenation conditions.

Claim 47 (new): The process according to claim 46, wherein the catalytic hydrogenation conditions comprise a hydrogenation reaction using Pd on activated carbon under a hydrogen atmosphere.

Claim 48 (new): The process according to claim 32, wherein the protective C₁-C₅ alkyl group is removed by using BBr₃.

Claim 49 (new): A process for the preparation of 3-A-oxy-estra-1,3,5(10),15-tetraen-17-one (6), comprising the steps of:

- (a1) converting the 3-OH group of estron (7) into a 3-AO group to form 3-A-oxy-estra-1,3,5(10)-trien-17-one (8);
- (b1) converting the 17-keto group of 3-A-oxy-estra-1,3,5(10)-trien-17-one (8) into a protected keto group to form 3-A-oxy-17-D-estra-1,3,5(10)-triene (9);
- (c1) halogenating C₁₆ of 3-A-oxy-17-D-estra-1,3,5(10)-triene (9) to form 3-A-oxy-16-X-17-D-estra-1,3,5(10)-triene (10), wherein X is a halogen atom selected from the group consisting of chloride, bromide and iodide;
- (d1) dehalogenating 3-A-oxy-16-X-17-D-estra-1,3,5(10)-triene (10) to 3-A-oxy-17-D-estra-1,3,5(10),15-tetraene (11); and

(e1) deprotecting the protected keto group of 3-A-oxy-17-D-estra-1,3,5(10),15-tetraene (11) to form 3-A-oxy-estra-1,3,5(10),15-tetraen-17-one (6);

wherein A is selected from a C₁-C₅ alkyl group or a C₇-C₁₂ benzylic group and wherein D is ethylene dioxy.

Claim 50 (new): The process according to claim 49, wherein the halogen atom is bromide.

Claim 51 (new): The process according to claim 49, wherein A is a methyl group.

Claim 52 (new): The process according to claim 49, wherein A is a benzyl group.

Claim 53 (new): A process for the preparation of 3-A-oxy-estra-1,3,5(10),15-tetraene-17-one (6), comprising the steps of:

- (a2) converting the 17-keto group of estron (7) into a protected keto group to form 17-D-estra-1,3,5(10)-trien-3-ol (12);
- (b2) converting the 3-OH group of 17-D-estra-1,3,5(10)-trien-3-ol (12) into a 3-AO group to form 3-A-oxy-17-D-estra-1,3,5(10)-trien-17-one (9);
- (c2) halogenating C₁₆ of 3-A-oxy-17-D-estra-1,3,5(10)-trien-3-ol (9) to form 3-A-oxy-16-X-17-D-estra-1,3,5(10)-trien-3-ol (10) wherein X is a halogen atom selected from the group consisting of chloride, bromide and iodide;
- (d2) dehalogenating 3-A-oxy-16-X-17-D-estra-1,3,5(10)-trien-3-ol (10) to 3-A-oxy-17-D-estra-1,3,5(10),15-tetraene (11); and
- (e2) deprotecting the protected keto group of 3-A-oxy-17-D-estra-1,3,5(10),15-tetraene (11) to form 3-A-oxy-estra-1,3,5(10),15-tetraen-17-one (6);

wherein A is selected from a C₁-C₅ alkyl group or a C₇-C₁₂ benzylic group, and wherein D is ethylene dioxy.

Claim 54 (new): The process according to claim 53, wherein the halogen atom is bromide.

Claim 55 (new): The process according to claim 53, wherein A is a methyl group.

Claim 56 (new): The process according to claim 53, wherein A is a benzyl group.

Claim 57 (new): The process according to claim 49, wherein the protected keto group D is formed by converting the 17-keto group with ethylene glycol.

Claim 58 (new): The process according to claim 53, wherein the protected keto group D is formed by converting the 17-keto group with ethylene glycol.

Claim 59 (new): The process according to claim 49, wherein steps (e1) and (e2) are carried out in the presence of a component selected from the group consisting of p-toluenesulfonic acid, pyridinium p-toluenesulfonate and pyridinium chloride.

Claim 60 (new): The process according to claim 49, wherein steps (e1) and (e2) are carried out in the presence of p-toluenesulfonic acid.

Claim 61 (new): The process according to claim 49, wherein steps (e1) and (e2) are carried out in the presence of p-toluenesulfonic acid monohydrate using aqueous acetone as solvent.

Claim 62 (new): The process according to claim 53, wherein steps (e1) and (e2) are carried out in the presence of a component selected from the group consisting of p-toluenesulfonic acid, pyridinium p-toluenesulfonate and pyridinium chloride.

Claim 63 (new): The process according to claim 53, wherein steps (e1) and (e2) are carried out in the present of p-toluenesulfonic acid.

Claim 64 (new): The process according to claim 53, wherein steps (e1) and (e2) are carried out in the presence of p-toluenesulfonic acid monohydrate using aqueous acetone as solvent.

Claim 65 (new): A pharmaceutical composition, comprising a carrier and the product obtainable by the method of claim 32.

Claim 66 (new): A method of hormone replacement therapy, of treating vaginal dryness, of contraception, of enhancing libido, of treating skin, of promoting wound healing or of treating or preventing an autoimmune disease, breast tumours or colorectal tumours, comprising administering the pharmaceutical composition of claim 65 to a subject in need thereof.

Claim 67 (new): A cosmetic method of treating skin, comprising administering topically the product obtainable by the process of claim 32.

Claim 68 (new): A compound according to formula 5, wherein A is a C₇-C₁₂ benzylic group.

Claim 69 (new): A compound according to formula 4, wherein A is a C₇-C₁₂ benzylic group and C is selected from monofunctional aliphatic hydroxyl protecting groups.

Claim 70 (new): A compound according to formula 3, wherein A is selected from a C₁-C₅ alkyl group or a C₇-C₁₂ benzylic group and C is selected from monofunctional aliphatic hydroxyl protecting groups.

Claim 71 (new): A compound according to formula 2, wherein C is selected from monofunctional aliphatic hydroxyl protecting group.

Claim 72 (new): A compound according to formula 10, wherein A is a C₇-C₁₂ benzylic group, D is ethylene dioxy and X is halogen.

Claim 73 (new): A compound according to formula 11, wherein A is a C₇-C₁₂ benzylic group and D is ethylene dioxy.